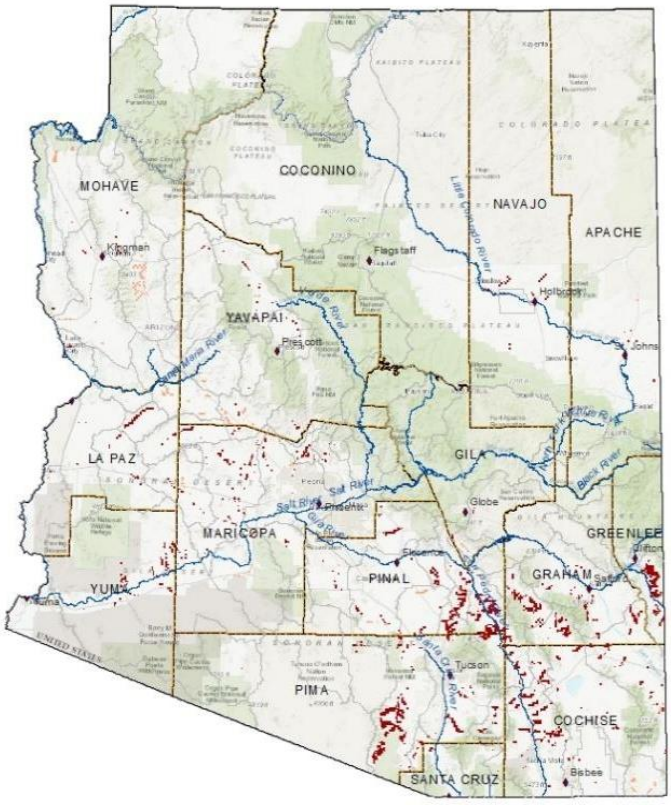
A Guide to Underground Water Storage Site Selection - **DRAFT**

Introduction

This document outlines the steps and considerations for potential underground storage of water in Arizona. It provides resources and information that individuals and groups can use as a guide during the process of evaluating underground water storage potential on public or private land, including Arizona State Trust Land. The steps outlined in this guide are generally applicable to potential sites around the state. The use of the word "storage" in this guide means both the storage of water underground pursuant to an underground storage facility permit issued by the Arizona Department of Water Resources (ADWR) and the addition of water to an aquifer through flood control projects and stormwater detention projects that do not require a permit from ADWR.

ADWR authored this guide with input from the Arizona State Land Department (ASLD) and the Governor's Water Augmentation, Innovation, and Conservation Council (Council) Storage Sites Subcommittee. We would like to acknowledge Cochise County Engineering and Natural Resources for providing examples of flood control structure projects that have been developed in Cochise County and that are currently providing storage in the aquifer in that region. John Ladd, fourth generation rancher and Chairman of the Hereford Natural Resource Conservation District Board of Supervisors, shared his experience developing the Horseshoe Draw Project. Nick Hont, retired senior engineer with Mohave County, supplied examples of projects in the Kingman area. We would also like to acknowledge Arizona State Representative Gail Griffin (District 14), an active member of the Council and the Storage Sites Subcommittee and a proponent of facilitating additional water storage in Arizona. Representative Griffin sponsored HB 2249 (Chapter 33, Laws 2021), which includes a provision requiring the State Land Commissioner and the Director of ADWR develop a plan to create additional above ground or underground water storage in this state that includes preliminarily investigating acceptable sites to construct new water storage facilities on State Trust Land.



In response to HB2249, ADWR identified sites located along streams that cross State Trust lands where the underlying material is conducive to storage. In some cases, factors such as proximity of potential sites to potential places of recovery and use and/or multiplicity of potential sites located on the same stream were used to eliminate isolated or potentially redundant sites. Sites located along canals, near the Colorado River and in areas with many existing Underground Storage Facility (USF) sites were also eliminated.

ADWR ultimately identified 331 possible underground storage sites (see inset) and published them in the 2021 report *Potential Underground Storage Sites on Arizona State Trust Land*. ADWR and the Storage Sites Subcommittee did not attempt to further refine the list of potential options or prioritize sites, recognizing that local stakeholders are best positioned to evaluate the opportunities available to them. This guide was developed to assist stakeholders in that process.

How to Use this Guide

There are five sections of evaluation criteria to this guide:

1. Initial Investigations
2. Technical Feasibility
3. Regulatory and Permitting Considerations
4. Facility Conceptual Development
5. Facility Design

This guide can be applied to any potential underground water storage site, including the 331 Arizona State Trust land sites identified by ADWR in the report *Potential Water Storage Sites on Arizona State Trust Land, 2021* [insert link to report once posted]. The sections are intended to be reviewed in the order they are presented and progress from high-level checklist items to more in-depth items that, if applicable to the site, would likely require professional consultant services to address. Links to websites and online tools provide detail beyond what is presented here.

Evaluation Criteria Number 1 – Initial Investigations

This list of initial investigations provides a check of conflicts between the intended project and current land use. These investigations are geared toward developing an understanding of the current and neighboring land uses and the individuals/entities on the land.

Land Status

Land status refers to the current land use. The online ASLD Parcel Viewer (http://gis.azland.gov/webapps/parcel/) is a resource for answering the following questions:

- Is the potential storage site located on Arizona State Trust land?
- Is there a lease associated with the Arizona State Trust land?
- If there is a lease:
    - What type? (Grazing, commercial, etc.)
    - What is the land being used for?
    - What is the length of the lease?

If the land is not State Trust land, it is still important to determine the ownership, development, and leasing or permitting status of the land if it is not already known. Ownership information can typically be found through the County Assessor.

In 2018, Flood Control District of Maricopa County adopted policy [upload PDF and link to it] that makes District lands acquired and used for flood control purposes to be made available at no cost

to Federal, State, County, and municipal agencies, and other political subdivisions of the State for the development of groundwater recharge, aquifer replenishment, and underground storage. The Flood Control Completed Projects and Property portal (https://gis.maricopa.gov/Flood-Parcels/) enables these properties to be explored.

Next, consider how the parcel and neighboring land is currently being used. Could the proposed storage project impact existing development, for example, by rising groundwater levels near an underground parking garage, waterlogging nearby agricultural fields, or inundating a mining or sand and gravel operation? Also consider if the proposed facility will create noise or an eyesore that neighboring properties might oppose, or if it might attract wildlife that would conflict with existing land uses, for example, birds near an airport. The applicant could be required to implement measures to mitigate any negative impacts on neighboring land. Aerial photographs can be one useful resource for determining neighboring land use, and there are a number of free online sources for these, including https://www.google.com/earth/ and https://www.bing.com/maps.

Environmental Considerations

Environmental considerations include the presence of landfills, surface/subsurface contamination, groundwater wells, and existing recharge sites. The Arizona Department of Environmental Quality (ADEQ) maintains databases of landfills and surface/subsurface contamination at the following websites:

- Landfills – http://azdeq.gov/node/5074
- Leaking Underground Storage Tank (LUST) – use ADEQ online mapper at http://gisweb.azdeq.gov/arcgis/emaps/?topic=assessed
- Water Quality Assurance Revolving Fund (WQARF) site registry – https://www.azdeq.gov/WQARF-Registry
- Other waste programs – http://azdeq.gov/WPD

ADWR maintains a database of registered wells and permitted recharge facilities:

- Registered wells – https://gisweb3.azwater.gov/WellReg
- Permitted recharge facilities – https://new.azwater.gov/recharge/permitted-facilities

If the proposed project is near any of the features discussed above, some questions to ask include:

- Could the proposed project cause the spread of pre-existing contamination?
- Could the proposed project negatively impact existing registered groundwater wells?
- Could the existing groundwater wells be used to monitor impacts from the proposed project?

The definition of "near" can be subjective and in this situation depends on the amount of water being recharged and physical qualities of the aquifer, among other things. Answering these questions may require the services of a hydrologist or engineer, so it is valuable to be aware of potential nearby sites/impacts, as this could increase the cost of the project.

Legal Considerations

Surface water use in Arizona is governed by the doctrine of prior appropriation, which can be summarized as, "first in time, first in right." A complex collection of laws and court decrees serves to administer water use throughout the state. Consultation with an attorney in the field of water rights law is recommended early in the process of evaluating and designing a potential storage project to avoid possible infringement on the water rights of others.

Evaluation Criteria Number 2 – Technical Feasibility

A technical feasibility evaluation ensures the conditions of land and water are right for a storage project.

These investigations are intended to provide an estimate of water availability and storage potential at the chosen site.

Water Availability

Precipitation volume, runoff, and frequency will determine how much stormwater may be available at a site. It is important to estimate these components during the siting and design phase of the project so that the facility can be located and sized properly. There are two ways to obtain this information: one is by contacting the local flood control district or emergency management department (depending on county, flood control may be part of emergency management), and the other is by using online calculators to estimate runoff volume at a specific site or watershed.

County flood control districts are tasked with reducing the risk of flood loss, minimizing the impact of floods by managing the floodplains, regulating development, providing public outreach and response, and restoring/preserving the natural benefits of floodplains. Early outreach to the appropriate county flood control district can inform the project on multiple levels: building requirements within a floodplain, existing flood hazards, and awareness of existing planned capital improvement projects. Maricopa County Flood Control District, for instance, is actively involved in enabling additional storage and is open to working with municipalities. The District has already conducted underground water storage feasibility studies and will have a list of "high potential" structures available in the near future.

Websites maintained by public and private entities can provide access to hydrologic information. The United States Environmental Protection Agency (USEPA) National Stormwater Calculator and the Model My Watershed tool developed by the Stroud Water Research Center are two examples.

- The USEPA National Stormwater Calculator, https://swcweb.epa.gov/stormwatercalculator/, provides site-specific average annual rainfall, estimated annual runoff, days per year with rainfall, and estimated smallest rainfall with runoff and largest rainfall without runoff.

- The Model My Watershed tool, at https://modelmywatershed.org/analyze, incorporates land use and soil data at a watershed level to provide site-specific estimates of stormwater runoff volumes and water quality.

- Stream Stats, https://streamstats.usgs.gov/ss/, is an online Geographic Information Systems (GIS) application maintained by the USGS. It provides users access to a variety of spatial analytical tools, such as basin characteristics and streamflow statistics, including peak-flow and flood-volume.

Storage Availability

The other consideration to technical feasibility is the infiltration ability and storage capacity of the surface and subsurface soils. Certain types of soil will allow water to infiltrate more readily than other types, for example sand allows for relatively more and faster infiltration compared to clay. Also, some areas of the state with shallow depth to bedrock have only tens of feet of unsaturated soil thickness available to store water underground, compared to other areas of the state where the unsaturated soil column can be hundreds of feet thick. Finally, depth to groundwater is a consideration, because groundwater near the land surface could limit or preclude potential water storage. The following resources will help evaluate the soil and storage conditions at the potential site.

- The Natural Resources Conservation Service Web Soil Survey, at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, provides a soil type and estimated infiltration rate at the surface. It can help evaluate if the surface soil at the proposed site is conducive to storage.

- The Arizona Geological Survey Estimated Depth to Bedrock map, available as a PDF at http://repository.azgs.az.gov/sites/default/files/dlio/files/2010/u15/DGM-52Map.pdf, shows the surface geologic unit as well as mapped depth to bedrock for the entire state of Arizona.

- The ADWR groundwater level database, at https://gisweb3.azwater.gov/gwsi, can provide an estimate of the depth to groundwater at the proposed site.

Taken together, these three evaluations can provide clarity on whether the proposed site is acceptable for underground storage. Generally, sites with higher infiltration rates and extensive depths to bedrock and groundwater are preferable.

Evaluation Criteria Number 3 – Regulatory and Permitting Considerations

Regulatory and permitting considerations are an important part of project planning. Knowing up front what regulations and permits may be required for the proposed project can help the design/build process go more smoothly. This section identifies a number of the common regulations and permits that may be needed for water storage projects. Not all of the regulations/permits listed here may be applicable to your specific project. However, there may be additional regulations or permits to consider, depending on the specifics of your project.

Federal Permits

Federal permits related to water storage facilities would generally be concerned with endangered species and/or waters of the United States (WOTUS). Online viewers and websites are available to help ascertain whether the proposed project will require one or more federal permits. These are discussed below.

- National Pollutant Discharge Elimination System (NPDES) Construction General Permit – required for any construction activity that will disturb one or more acres of land and discharges stormwater to WOTUS. See FAQs at: https://www.epa.gov/npdes/construction-general-permit-cgp-frequent-questions. Note that Arizona received authority from the EPA to administer its own version of the NPDES program, so if this permit is applicable to the proposed project, the state-run AZPDES permit would be obtained from the Arizona Department of Environmental Quality (ADEQ) instead of the federal NPDES permit.

- A permit under Section 404 of the Clean Water Act (CWA), issued by the United States Army Corps of Engineers (USACE) – required for any activity that occurs within WOTUS. The applicant would need to either assume the risk of determining whether or not the construction activity intersects WOTUS or coordinate with the USACE for a formal decision. ADEQ is working on an online toolkit to help assess which waters may be jurisdictional under the Clean Water Act. Refer to this website for more information: https://azdeq.gov/wotus.

    - State Water Quality Certification, CWA Section 401 – a state permit issued by ADEQ that is required for any project that has a federal Section 404 permit. See "State Permits" section, below, for more information.

- The United States Fish & Wildlife Service (FWS) enforces the Endangered Species Act – consultation with the FWS is required if construction activities could impact a listed species and/or critical habitat. This online viewer provides a state-wide overview of

critical habitat and associated species and can be used to evaluate whether the proposed project will occur within a critical habitat area:

https://www.arcgis.com/home/webmap/viewer.html?url=https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer&source=sd

State Permits

Permits from the state of Arizona are broadly related to environmental concerns, archaeological preservation, protected wildlife habitat, and water resources. Discussion of the various agencies and potentially applicable permits is presented below.

- ADEQ has a mission to protect and enhance public health and the environment. Permits related to water quality and air quality fall under the purview of ADEQ.
    - Aquifer Protection Permit (APP) – this permit may be required if discharge to the aquifer will occur. See https://www.azdeq.gov/APP/ComplianceAssistance.
    - Arizona Pollutant Discharge Elimination System (AZPDES) – this permit may be required if in-stream recharge will occur. Consult with ADEQ to determine if this permit is required and note that the AZPDES permit would be completed in place of a federal NPDES permit. If the project requires an AZPDES permit, it will also need a Stormwater Pollution Prevention Plan (SWPPP). See: https://azdeq.gov/AZPDES/SWPPP
    - State Water Quality Certification, CWA Section 401 – this permit is required for any project that has a federal Section 404 permit. Refer to this website for more information: https://azdeq.gov/cwa401

- ADWR has a mission to protect, conserve, and enhance the state's water supplies. Permits related to water rights, dam safety, and underground storage fall under the purview of ADWR.
    - Jurisdictional Dam – for projects that include the construction of a retention structure, check if the proposed structure design falls under the definition of "dam" under A.R.S. § 45-1201. If it does, additional permitting and inspection requirements would apply. See: https://new.azwater.gov/dam-safety/faq
    - Notice of Intent – this form is required to be submitted to ADWR in advance of drilling, modifying, or abandoning any type of groundwater well. See: https://new.azwater.gov/permitting-wells/well-forms-and-applications
    - Surface water permit – if capturing, impounding, or diverting water within any natural drainage, you must apply for and obtain a permit and certificate to appropriate surface water. See: https://new.azwater.gov/surface-water
    - Underground Storage Facility permit – this permit is required for any projects that intend to and actually add water to an aquifer.
      See: https://new.azwater.gov/recharge/applications

- The Arizona Game and Fish Department (AZGFD) is tasked with managing, conserving, and protecting wildlife, including non-game and endangered wildlife. Although not associated with any permit requirement, if the proposed project falls within a critical habitat area (see Federal section, above), coordinating with the AZGFD prior to contacting federal agencies is recommended.

- The Arizona State Historic Preservation Office (SHPO), part of the Arizona State Parks Department, assists in the identification and protection of historic and archaeological properties that have significance for local communities, the state of Arizona, and/or the nation. Consulting with the SHPO prior to conducting groundbreaking activities is recommended to ensure that cultural resources are not inadvertently impacted.

County and Local Permitting

County and local jurisdictions may have their own set of permits or constraints. For example, Maricopa County requires Dust Control Permits when earthmoving operations disturb an area greater than one tenth of one acre, whereas Pima County requires a Fugitive Dust Activity Permit when earthmoving operations disturb over one acre. Check with the specific county to understand what is applicable for the proposed project. As mentioned in Evaluation Criteria Number 2, consultation with the appropriate County Flood Control District is recommended.

Evaluation Criteria Number 4 – Facility Conceptual Development

The following are some considerations for the physical design of the storage facility. Some of these items address near-term project logistics while others are long-term considerations to ensure the project is functional and providing the intended benefit for the projected lifespan.

- How do you plan to deliver the water to the aquifer? (Discharge to a natural watercourse or a constructed facility, direct injection, etc.)
- What is the approximate acreage of the proposed facility?
- Is there potential for more than one use? For example, could the project have a public park, potential wildlife habitat, or add value to an existing national or state park?
- What is the anticipated lifespan of the project?
- How will you determine the success of the project? Will there be groundwater monitoring or other professionally accepted methods to estimate the benefit of the project to the aquifer?
- What will long-term care of the project look like? (anticipated operation and maintenance requirements)
- Are there public and/or private funding sources, such as grants, that could offset some of the costs of construction?

Evaluation Criteria Number 5 – Facility Design

Focused investigations that would occur after the high-level planning is completed will likely need to be completed by consultants who specialize in subsurface and water-related projects in Arizona. Costs for these investigations can range from tens to hundreds of thousands of dollars, depending on the site-specific characteristics and complexity.

- Subsurface investigations
    - Deep – borehole drilling to characterize alluvial material
    - Shallow – test pits, cylinder infiltrometer tests to characterize surface material
- Hydrologic/hydraulic calculations
    - Design storm flood conditions
    - Catchment design
- Detailed legal review for potential infringement of existing water rights
- Insurance needs for private facilities
- Engineer design plans and opinion of probable cost

Summary

Developing an underground water storage project in Arizona has been done successfully in many locations across the state. The scope of underground water storage in Arizona varies from one or more injection wells to constructed basins to large-scale managed underground storage projects adjacent to major waterways. No one project looks exactly like another, but the common goal is to conserve water for future uses.

The links below provide examples of existing projects:

1. Palominas Stormwater Recharge and Flood Control Project
   https://ccrnsanpedro.org/palominas/
2. City of Kingman Reclaimed Water Injection Well
   https://www.cityofkingman.gov/Home/Components/News/News/1557/255?arch=1
3. Salt River Project's Granite Reef Underground Storage Project and New River-Agua Fria River Underground Storage Project
   https://www.srpnet.com/water/resource-management.aspx
4. Town of Prescott Valley Effluent Recharge
   https://www.pvaz.net/244/Water-Reuse-Recharge